IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

REPLY BRIEF FOR THE APPELLANT

Ex parte **Jun TAKADA et al.** (Appellants)

NITRIDED MO ALLOY WORKED MATERIAL HAVING HIGH CORROSION RESISTANCE, HIGH STRENGTH AND HIGH TOUGHNESS AND METHOD FOR PRODUCTION THEREOF

Application Number: **10/509,156**

Filed: **November 1, 2005**

Appeal No.: **Not Yet Assigned**

Art Unit: **1793**

Examiner: **Weiping Zhu**

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In re the Application of: **Jun TAKADA et al.** Art Unit: **1793**

Application Number: **10/509,156** Examiner: **Weiping Zhu**

Filed: **November 1, 2005** Confirmation No.: **5033**

For: **NITRIDED MO ALLOY WORKED MATERIAL HAVING HIGH CORROSION RESISTANCE, HIGH STRENGTH AND HIGH TOUGHNESS AND METHOD FOR PRODUCTION THEREOF**

Attorney Docket Number: **042724**
Customer Number: **38834**

REPLY BRIEF

Mail Stop: Appeal brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

February 5, 2010

Sir:

In response to the Examiner's Answer mailed on December 17, 2009, the following is the Appellants' Reply Brief. This paper has been timely filed.

I. REMARKS

In the Examiner's Answer, the Examiner basically repeated the same argument in the previous Office Action. The following arguments supplement the Appeal Brief.

1. Takada et al. And JP ('770 A) Are Not Simply Combinable

The Examiner alleges that the present invention is obvious because:

> First, the appellant argues that the examiner applies inherency to a combination of prior art improperly; nothing in JP ('770 A) indicates that a Mo nitride layer formed by a nitriding treatment would increase the mechanical strength and hardness of a Mo based alloy; and it was not known to a person of ordinary skill in the art that a thin Mo nitride surface layer would contribute to the yield strength in a practical manner. In response, the examiner notes that claims 1 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 01/18276 A1 in view of JP 11-286770 A. The combination of the prior art references as the ground of rejection is believed to be proper and is maintained.

(Examiner's Answer, page 4, lines 14-22).

Now it is acknowledged that the Examiner's allegation is based on that claims 1 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 01/18276 A1 (Takada et al.) in view of JP 11-286770 A, but not on the previously alleged basis that the yield strength of the worked Mo alloy material with the Mo nitride surface layer would be **inherently higher** than that of the worked Mo alloy material without the Mo nitride surface layer of Takada et al. ('368).

The Examiner alleges regarding the yield strength of the worked Mo alloy material as follows:

> The yield strength of the worked Mo alloy material with the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A) would be expected by one of skill in the art to be higher than that of the worked Mo alloy material without the Mo nitride surface layer because **JP ('770 A) discloses that a Mo nitride surface layer formed by a nitriding treatment would increase the mechanical strength and hardness of a Mo-based alloy**(abstract and paragraph [0006], machine translation).

(Examiner's Answer, page 4, line 22 to page 5, line 5). The allegation is not supported by the description of JP('770 A). The abstract of JP('770 A) describes as follows:

> PROBLEM TO BE SOLVED: To impart a corrosion performance equal to that of Ta to a material and to obtain a **mechanical strength** and hardness more excellent **than those of Ta** by subjecting Mo and an Mo-based alloy to nitriding treatment.

The nitriding treatment is employed not because it would increase the mechanical strength and hardness of a Mo-based alloy. Young's modulus of Mo is 33,100 kgf/mm^2 and this value is much higher than that of Ta, which is 18,200 kgf/mm^2. Therefore, mechanical strength and hardness of Mo is more excellent than those of Ta regardless the nitriding.

Also, paragraph [0006] of the of JP('770 A) should be read with its preceding paragraphs as follows:

> [0004] [The issue which it is going to solve by invention] Although **Ta currently used** actually has the performance which was excellent about corrosion resistance, a **mechanical strength is low**, wear and degradation are remarkable, and prolonged use is difficulty (there is no endurance). And there were problems, like specific gravity is large, is expensive and there is.
> [0005] Although it was known that surface nitriding of Mo system alloy can be performed, there was a problem that no it was known how it excels, what kind of the characteristic there is, or how it can be used.

> [0006] [Means for Solving the Problem]nitriding treatment of the Mo system alloy is carried out to a basis of appropriate alike conditions certain in this invention, and a film of nitriding Mo is provided in the surface. Therefore, **it excelled in corrosion resistance, a mechanical strength was large**, and it succeeded in obtaining a cheap and lightweight composite material.

Thus, nothing indicates that "a nitriding treatment would increase the mechanical strength and hardness of a Mo-based alloy" despite the Examiner's allegation.

Therefore, the descriptions in JP('770) do not support the Examiner's allegation that the yield strength of the worked Mo alloy material with the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A) would be expected to be higher than that of the worked Mo alloy material without the Mo nitride surface layer.

The Examiner also alleged as follows:

> Second, the appellant argues that Takada et al. ('368) in view of JP ('770 A) does not disclose the claimed features in the instant claim 1 without specifying the exact feature. In response, see the grounds of rejections of the instant claims 1 and 7 as stated in the Section VIIII above.

(Examiner's Answer, page 5, lines 5-8).

The Examiner alleged at the Section VIIII as follows:

> With respect to claims 1 and 7, Takada et al. ('368) discloses a worked Mo alloy material subjected to nitriding, which has high strength and high toughness comprising fine nitride particles formed by internally nitriding a nitride-forming metal element incorporated as a solid solution in the worked Mo alloy material and the fine nitride particles being dispersed in a worked structure on an interior recrystallized structure or an interior structure without recrystallization (col. 3, lines 28-46).
>
> Takada et al. ('368) does not disclose that the worked Mo alloy material comprises a Mo nitride layer at the surface of the worked Mo alloy material as claimed.

> JP ('770 A) discloses a Mo alloy with a Mo nitride layer having a thickness of 0.5 to 10 microns at the surface (abstract) and the Mo nitride at the surface comprising gamma-Mo2N, beta-Mo2N and delta-MoN (paragraph [0003], machine translation). The thickness range of the Mo nitride layer of JP ('770 A) overlaps the claimed thickness range. A prima facie case of obviousness exists. See MPEP 2144.05 I. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Mo nitride layer at the surface of the worked Mo alloy material of Takada et al. ('368) as disclosed by JP ('770 A) in order to improve the corrosion resistance and the mechanical strength of the worked Mo alloy material of Takada et al. ('368) as disclosed by JP ('770 A) (abstract and paragraph [0006], machine translation). The yield strength of the worked Mo alloy material with the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A) would be inherently higher than that of the worked Mo alloy material without the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A).

(Examiner's Answer, VIIII).

However, Takada et al. and JP ('770 A) are not simply combinable. Takada et al. explains as follows:

> According to the manufacturing method of the present invention, in the first nitriding treatment, nitrogen diffuses in the worked piece with keeping the worked structure of the diluted alloy worked piece to **preferably nitride the nitride-forming metal element** incorporated into the parent phase as a solid solution so as to form the ultra-fine nitride particles and disperse them throughout the parent phase. The term "diluted alloy" herein means an alloy including a dissolved element as a solid solution alloy in low concentration or at a small amount of about 5 weight % or less. The term **"preferred nitriding" herein means a phenomenon that not the metal in the parent phase but only the nitride-forming element is nitrided preferably**.
>
> As compared with conventional nitriding processes, the manufacturing method of the present invention is characterized by the multi-step nitriding. **The nitriding treatments in the multi-step nitriding according to the present invention provide different effects, respectively.** . . .

(See USP6,589,368, column 4, lines 11-28). Thus, Takada et al. discusses "preferred nitriding," and the description indicates that the parent phase, **Mo, is not nitrided because of the preferred nitriding**. In other words, according to Takada et al. it is not necessary for Mo to be nitrided. Therefore, a person of ordinary skill in the art would not be motivated to nitride Mo of the alloy material in Takada et al.

Takada et al. also indicates that each of the nitriding treatments in the multi-step nitriding according to Takada et al. respectively provide different effects. Therefore, additional different nitriding treatment can have adversely effect. Even if a person of ordinary skill in the art is aware of JP ('770), there is no reason for the person to combine the teaching of Takada et al with the teaching disclosed in JP ('770).

The inventors found that external nitriding under a strong nitriding atmosphere makes it possible to form a molybdenum nitride layer on the molybdenum alloy material containing nitride-forming-metal element dissolved in a molybdenum matrix and also found that the worked molybdenum-alloy material thus obtained has high strength and high toughness, in addition to corrosion resistance against oxidizing acids.

Therefore, claims 1 and 7 are not prima facie obvious over the combination of Takada et al. and JP 11-286770.

2. Results of Present Invention Were Not Expected

The Examiner further alleged as follows:

> Third, the appellant argues that the instant invention shows unexpected results compared with Takada et al. ('368) in terms of yield and maximum strengths as shown in Table 1 in the Appeal Brief; it was not expected for a person having ordinary skill in the art that there is correlationship between the yield strength of the Mo alloy worked material and the thickness of the thin Mo nitride surface layer formed on the Mo alloy; and the worked material of the instant invention exhibits high corrosion resistance as well as very high strengths. In response, the examiner notes that JP ('770 A) discloses that a Mo nitride surface layer formed by a nitriding treatment on a Mo alloy would have excellent corrosion resistance, mechanical strength and hardness (abstract and paragraph [0006], machine translation) and the thickness range of the Mo nitride layer of JP ('770 A) overlaps the claimed thickness range as stated in the Section VIIII above.
>
> Appellant's position is stated by way of argument alone and therefore not considered to be of probative value. Evidence of non-obviousness such as criticality of ranges or unexpected results may be appropriate for a declaration under 37 CFR 1.132. See MPEP section 716.02. Furthermore, Takada et al. ('368) in view of JP ('770 A) meets all the claim limitations in the instant claims 1 and 7 as discussed above. The same corrosion resistance and mechanical strengths would be expected in the product of Takada et al. ('368) in view of JP ('770 A) as in the instantly claimed product.

(Examiner's Answer, page 5, lines 5-8). However, as discussed above, the nitriding of Takada et al. is different from that of JP ('770). Even if a person of ordinary skill in the art is aware of JP 11-286770, there is no reason for the person to combine the teaching of Takada et al. with the teaching disclosed in JP ('770). Also, there is no reason that a person of ordinary skill in the art could have expected the results of the present invention.

JP ('770 A) describes on the thickness of the Mo nitride layer as follows:

> In said invention, if nitriding temperature exceeds less than 700°C or 1150°C, an outstanding Mo_2N layer of the target corrosion resistance will not be made. When Mo_2N layer thickness is less than 0.5 micrometer, or

> also when exceeding 10 micrometers, it is difficult to acquire corrosion resistance made into the purpose of this invention.

(JP ('770 A), paragraph [0009]). Thus, **JP ('770 A) simply indicates that Mo_2N layer** thickness between 0.5 micrometer and 10 micrometers **is preferable for the purpose of corrosion resistance**. Nothing in JP ('770 A) indicates that the Mo_2N layer improves the strength of the molybdenum-alloy material.

(Table 1)

	Pure Mo	Material subjected to internal nitriding up to third step	(Internal nitriding up to third step) + (external nitriding) (2.8 μm)
Yield strength	550 MPa	1190 MPa	1280 MPa
Maximum strength	750 MPa	1620 MPa (amended Feb. 27, 2009)	1870 MPa

In contrast, Table 1 above shows the relationship between the temperature of heating treatment and the thickness of the surface layer of a Mo-Ti-alloy (see page 11 of the present specification). The yield strength and the maximum strength significantly increase by the external nitriding. Although it would be preferable to increase the layer thickness for corrosion resistance, the present inventors found that toughness was reduced with the increase in layer thickness. Thus, the present inventors also found that thickness of molybdenum nitride layer should be 3 μm or less. These are not expected from the combination of Takada et al. and JP ('770 A).

II. CONCLUSION

For at least the above reasons, the present invention as recited in claims 1 and 7 patentably distinguishes over the combination of Takada et al. and JP ('770 A).

Appellants request that the Honorable Board reverse the Examiner's rejection.

If this paper is not timely filed, Appellants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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